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D'APPOLONIA CONSULTING ENGINEERS PITTSBURGH PA  
NATIONAL DAM SAFETY PROGRAM. TIPTON DAM (NDI I.D.-525), SUSQUEH--ETC(U)  
SEP 78

F/G 13/2  
DACP31-78-C-0049  
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LEVEL II

SUSQUEHANNA RIVER BASIN  
TIPTON RUN, BLAIR COUNTY

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PENNSYLVANIA

National Dam Safety Program. Tipton  
Dam (NDI I.D.-525), Susquehanna River  
Basin, Tipton Run, Blair County,  
Pennsylvania. Phase I Inspection Report.

TIPTON DAM

NDI I.D. NO: 525

15

DACW 31-78-C-0049

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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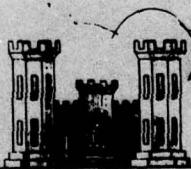
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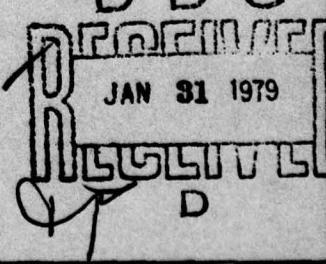
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PREPARED FOR

DEPARTMENT OF THE ARMY  
BALTIMORE DISTRICT, CORPS OF ENGINEERS  
BALTIMORE, MARYLAND 21203

BY  
D'APPOLONIA CONSULTING ENGINEERS  
10 DUFF ROAD  
PITTSBURGH, PA. 15235  
SEPTEMBER 1978



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# LEVEL II

(1)

## PHASE I REPORT NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Tipton Dam  
 STATE LOCATED: Pennsylvania  
 COUNTY LOCATED: Blair  
 STREAM: Tipton Run, tributary of Little Juniata River  
 DATE OF INSPECTION: July 11 and 18, 1978

AC NUMBER		DDC Section
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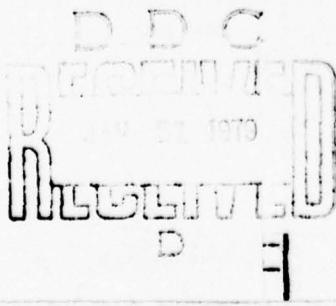
ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observations, the condition of Tipton Dam is assessed to be good.

However, because the owner declined to operate the blow-off valve for the dam, the operational condition of the drawdown facilities for the reservoir could not be assessed.

It is therefore recommended that the owner immediately assess the functional condition of the operating facilities and perform necessary maintenance, as required.

The overflow section of the dam does not have the recommended capacity to pass the probable maximum flood without overtopping. However, the dam is a masonry structure, and overtopping by the probable maximum flood would not significantly affect the stability of the dam. Therefore, the spillway capacity is considered to be adequate. However, during unusually heavy runoff, when overtopping might occur, an around-the-clock surveillance plan should be implemented to detect possible problems, such as rapid erosion of the abutments.

It is recommended that the owner should develop a formal warning system to alert the downstream residents in the event of emergencies and repair the spalling concrete capping blocks and side walls of the plunge pool.



*Lawrence D. Andersen*

Lawrence D. Andersen, P.E.  
Vice President

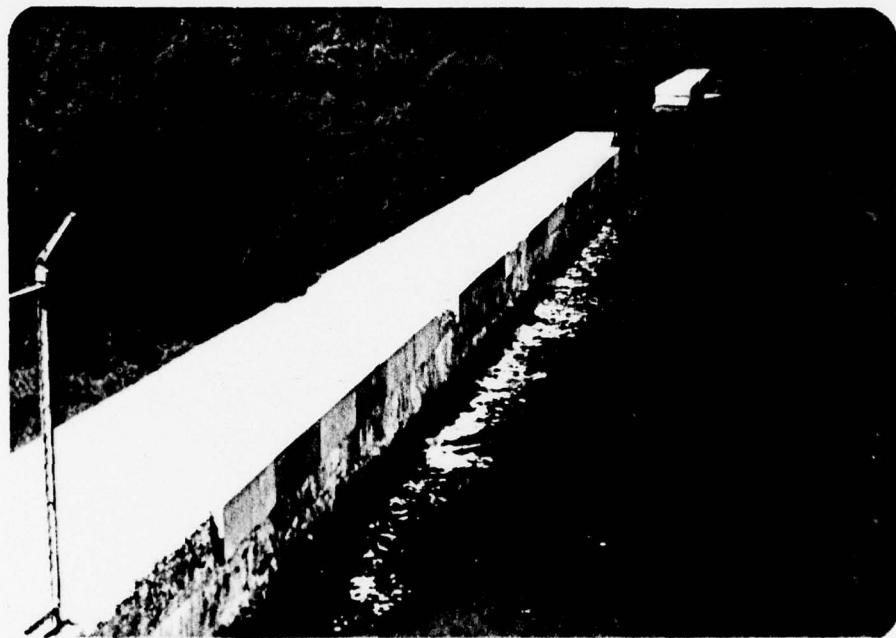
*G. K. Withers* 23 Sep 78

G. K. WITHERS  
Colonel, Corps of Engineers  
District Engineer  
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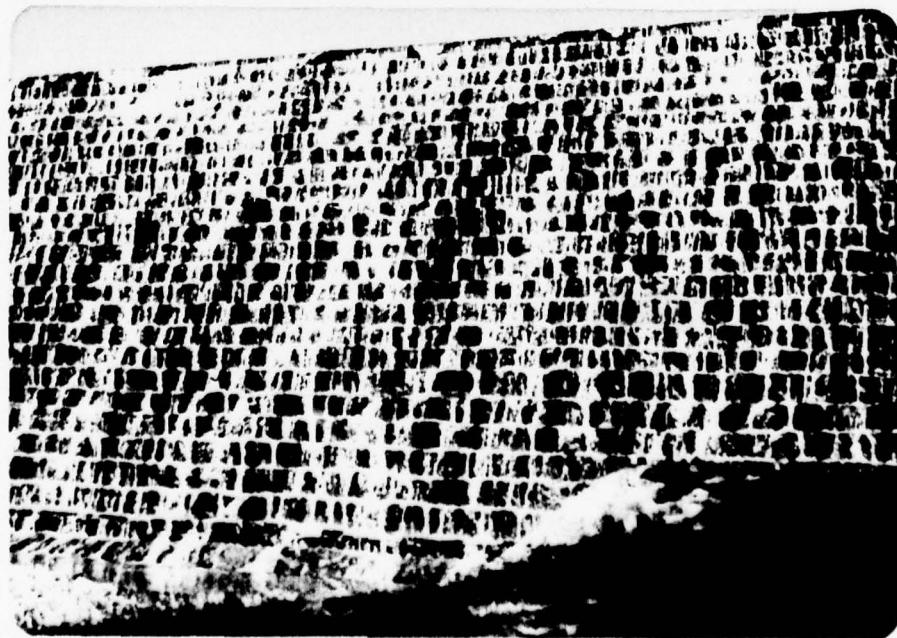
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TIPTON DAM  
NDI I.D. NO. 525  
JULY 11, 1978



Upstream Face



Downstream Face

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PHASE I  
NATIONAL DAM INSPECTION PROGRAM  
TIPTON DAM  
NDI I.D. NO. 525  
DER I.D. NO. 7-67

*ABSTRACT*  
SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. → The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. Tipton Dam is a masonry gravity structure approximately 555 feet long with a maximum height of 66 feet from the downstream toe (Plate 1). A 150-foot-long section four feet below the crest is the overflow section of the dam. This section discharges down the face of the dam to a plunge pool. The outlet works consist of a 36-inch cast-iron blow-off pipe and a 24-inch cast-iron supply line, both located near the left side of the spillway. Discharge through these pipes is controlled by sluice gates located on the upstream face of the dam and by valves located in the valve house near the toe of the dam. The 36-inch blow-off pipe constitutes the emergency drawdown system for the dam. The dam impounds 1120 acre-feet of water at normal pool level.

b. Location. The dam is located on Tipton Run about 5 miles upstream of its confluence with the Little Juniata River and 6 miles west of Tyrone in Antis Township, Blair County, Pennsylvania (Plate 2).

Downstream from the dam, Tipton Run flows through a narrow valley for about two miles where the valley widens. Further downstream, the run flows through rural residential areas for about 2 miles and then under the Penn-Central Railroad south of the town of Tipton and joins the Little Juniata River, just upstream of where the Little Juniata River crosses U.S. Route 220.

It is estimated that in the event of a failure, loss of life and property damage would be high. Over one hundred homes would be within the main impact area of a flood due to dam failure. A railroad and a major highway would also receive significant damage.

c. Size Classification. Intermediate (based on 66-foot height).

d. Hazard Classification. High.

e. Ownership. Blair Gap Water Company (address: Mr. James Dotson, Manager, Blair Gap Water Company, Box 20, Greenwood Road, Altoona, Pennsylvania 16602).

f. Purpose of Dam. Water supply.

g. Design and Construction History. Tipton Dam was designed and constructed by the Tipton Water Company, a subsidiary of the Pennsylvania Railroad Company. The construction of the dam was completed in December 1924.

h. Normal Operating Procedure. The reservoir is maintained at spillway level, Elevation 1394 (USGS Datum), leaving four feet of freeboard to the top of the dam at Elevation 1398. Although the as-built drawings show the dam crest elevation as 1395, a USGS bench mark installed on the crest of the dam (near the left abutment) in 1962 shows the crest to be at Elevation 1398. All inflow occurring when the reservoir level is at the spillway crest or above is discharged over the uncontrolled spillway.

### 1.3 Pertinent Data

a. Drainage Area - 9.6 square miles

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - 1125 (2 feet over the spillway section in 1972)

Warm water outlet at pool elevation - N/A

Diversion tunnel low pool outlet at pool elevation - Unknown

Gated spillway capacity at pool elevation - N/A

Gated spillway capacity at maximum pool elevation - N/A

Ungated spillway capacity at maximum pool elevation - 3700<sup>(1)</sup>

Total spillway capacity at maximum pool elevation - 3700<sup>(1)</sup>

c. Elevation (USGS Datum) (feet)

Top of dam - 1398

Maximum pool-design surcharge - N/A

Full flood control pond - N/A

Recreation pool - 1394 (normal)

Spillway crest - 1394

<sup>(1)</sup>Overflow section of dam only.

Upstream portal invert diversion tunnel - 1318+  
Downstream portal invert diversion tunnel - 1315+  
Streambed at center line of dam - 1316+  
Maximum tailwater - Unknown

d. Reservoir (feet)

Length of maximum pool - 1000+ at Elevation 1394  
Length of recreation pool (normal) - 1000+ at Elevation 1398  
Length of flood control pool - N/A

e. Storage (acre-feet)

Recreation pool (normal pool) - 1120 at Elevation 1394  
Flood control pool - N/A  
Design surcharge - 1304 at Elevation 1398  
Top of dam - 1304 at Elevation 1398

f. Reservoir Surface (acres)

Top of dam - 46+ at Elevation 1398  
Maximum pool - N/A  
Flood control pool - N/A  
Recreation pool - 46 (normal) at Elevation 1394  
Spillway crest - 46 at Elevation 1394

g. Dam

Type - Masonry gravity  
Length - 555 feet  
Height - 66 feet  
Top width - 7 feet  
Side slopes - Vertical upstream; 2H:3V downstream  
Zoning - N/A  
Impervious core - N/A  
Cutoff - Yes  
Grout curtain - Yes

h. Diversion and Regulating Tunnel

Type - 36-inch-diameter cast-iron pipe  
Length - 70+ feet  
Closure - Upstream sluice gate  
Access - On dam crest and valve house at toe  
Regulating facilities - Sluice gate

i. Spillway

Type - Overflow section of dam  
Length of weir - 150 feet

Crest elevation - 1394 feet  
Gates - None  
Upstream channel - Lake  
Downstream channel - Natural stream

SECTION 2  
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. Review of the information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), showed that there are no original hydrology and hydraulic design data available for the dam. However, a state report entitled, Report Upon the Application of Tipton Water Company, dated May 21, 1923, states the criteria used to size the spillway.

(2) Dam. The 1923 inspection report includes the results of an independent stability analysis.

(3) Appurtenant Structures. No design information is available.

b. Design Features

(1) Dam. As designed, the dam is a "boulder concrete" wall faced with rubble masonry. Plate 1 illustrates the typical cross section of the dam and lists various pertinent quantities. The cross section consists of essentially a vertical upstream face and a seven horizontal to ten vertical (7:10) sloping downstream face. The crest is capped with 7-foot-wide and 2-foot-thick concrete coping blocks.

A magazine article published in the January 1925 issue of The Manual Magazine prepared by Mr. Charles Haydock, an engineer who was involved in the construction of the dam, provides detailed information on the construction of the dam. Review of this information and state reports show the following main features of the project.

1. Preliminary subsurface exploration at the site consisted of numerous test pits and borings. Plate 3 illustrates the subsurface conditions at the site which consists of layers of sandstone and shale. In addition to the borings shown in Plate 3, two additional borings were drilled to a depth of 250 feet for the investigation.

2. As shown in Plate 4, the dam design included a cutoff wall and a grout curtain at the heel of the dam cutoff wall, extending approximately 15 feet into the rock. The base of the cutoff wall was stage grouted through 20-foot-deep holes. The final spacing of grout holes was five feet. After completion of this grout curtain, additional grout was pumped into the foundation rock through ten 75-foot-deep holes.
3. The crest of the dam and the overflow section was capped with precast concrete capping blocks.

(2) Appurtenant Structures. The spillway is a low section of the dam. The crest of the spillway is capped with 7-foot-wide concrete capping blocks. The flow from the spillway discharges down the face of the dam to a masonry apron, then to a plunge pool. The outlet works of the dam consist of a 36-inch cast-iron blow-off pipe and a 24-inch supply line. The supply line is connected to a riser pipe built into the dam. The riser pipe has two inlets at Elevations 1373 and 1360 controlled by sluice gates on the upstream face of the dam (Plates 4 and 5).

d. Design Data

(1) Hydrology and Hydraulics. The 1923 state report indicates that design inflow to the reservoir was taken as 650 cubic feet per second (cfs) per square mile of watershed, a total flow of 5800 cfs. In this design, one foot overflow across the entire dam crest was permitted.

(2) Dam. The 1923 state report indicates that using an upward hydrostatic pressure under the entire base of the dam, varying two-thirds of the maximum water pressure at the upstream toe to zero at the downstream toe, the resultant force was calculated to be 1.3 feet outside the middle one-third of the base. The report further states that because precautions were taken to control seepage through the foundation, the uplift pressure distribution used was believed to be excessive; therefore, the dam was considered safe against overturning.

(3) Appurtenant Structures. No design data were found relative to the design of appurtenant structures except as stated above.

2.2 Construction. The 1925 magazine article provides a detailed description of the construction of the dam. Accounts indicate that the dam was built with adequate care. The construction was inspected weekly by Mr. J. W. Ledoux, a consulting engineer who had wide experience in design and construction of masonry dams.

2.3 Operation. There are no formal operating records available for this dam. The dam serves as a water supply reservoir.

2.4 Other Investigations. The available information includes various periodic inspections conducted by the state since 1925. The last state inspection was conducted in 1976. In 1972, the dam was inspected by U.S. Bureau of Reclamation personnel, following Tropical Storm Agnes. Although the dam was assessed to be in need of maintenance, no major concerns were raised.

## 2.5 Evaluation

a. Availability. The available information was provided by PennDER.

### b. Adequacy

(1) Hydrology and Hydraulics. Available engineering data are not adequate to assess the structure. Only the design capacity of the spillway is reported.

(2) Dam. The 1923 report states the results of an independent stability analysis which considered the stability of the structure against overturning with and without hydrostatic uplift pressure. No calculations were available for review.

(3) Appurtenant Structures. Design drawings indicate that the flow from the blow-off and the supply lines through the dam can be controlled by valves located at the downstream valve house and by the sluice gate on the upstream side of the dam.

c. Operating Records. To the best knowledge of the water company personnel, no operating difficulties have been encountered in the past. A state inspection report dated May 14, 1936, states that during the flood in March 1936 the maximum depth of flow over the spillway was 1.2 feet.

A state inspection conducted on July 18, 1972, following Tropical Storm Agnes, reports that the depth of water over the spillway section during that flood was about 2 feet.

d. Post-Construction Changes. There have been no reported significant modifications to the original dam design. Field observations indicate that the masonry joints on the downstream face have been recently repaired.

e. Seismic Stability. The dam is located in Seismic Zone 1 and static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structure is assumed to present no hazard from earthquake.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Tipton Dam consisted of:

1. Visual inspection fo the retaining structure, abutments, and toe.
2. Visual examination of the spillway and its components, the downstream end of the outlet pipe, and other appurtenant features.
3. Observation of factors affecting the runoff potential of the drainage basin.
4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 6 and in the photographs in Appendix C.

b. Dam. The general inspection of the retaining structure consisted of searching for indications of structural distress, such as cracks and deterioration of rock surfaces, seepage areas, and observing general maintenance conditions and other surficial features.

1. One area of the dam on each side of the spillway was found to be wet. Several seeps were located on the left, about 10 feet below the crest of the dam over a distance of about 20 feet. Total seepage from the left side was estimated to be 4 to 6 gallons per minute (gpm). Seepage through the right side of the spillway was estimated to be 2 to 4 gpm.
2. Several concrete capping blocks on the crest of the dam have deteriorated, exposing reinforcing. They should be repaired before further weathering occurs.

c. Appurtenant Structures. The spillway crests and plunge pools were examined for deterioration or other signs of distress and obstructions that would limit flow. No signs of apparent distress or erosion were observed. The concrete walls on each side of the plunge pool were found to be significantly deteriorated, requiring repairs. Water company personnel declined to operate the blow-off valve so its condition could not be assessed.

d. Reservoir Area. The watershed is predominantly covered with woodlands and infiltration capacity is estimated to be good.

The shorelines are not considered to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displaced water.

e. Downstream Channel. Tipton Run, over a distance of about two miles upstream from its confluence with the Little Juniata River, flows through suburban residential areas. The stream crosses one main railroad and flows into the Juniata River immediately upstream of a bridge on Route 220. The photographs in Appendix C show the bridges on the Penn Central Railroad and on Route 220.

3.2 Evaluation. In general, the condition of the dam is considered to be good. However, the operative condition of the drawdown facility of the dam could not be assessed because the water company declined to operate the blow-off valve for the reservoir without compensation for the service and compensation for any damages caused by the operation of the valve. Visual observations indicate that the operating facilities are in fair condition.

SECTION 4  
OPERATIONAL FEATURES

4.1 Procedures. A review of the design drawings and field observations indicates that there are no formal procedures for operating the dam. The only operational feature of the dam which may affect the safety of the dam is the outlet pipe valve, in case it is required to lower the reservoir.

The clearing of debris from the spillway, removal of the brush from the downstream toe area as necessary, and continued inspection of the facilities by the dam tender are the principal maintenance operations which would affect safety.

4.2 Maintenance of the Dam. The overall maintenance condition of the dam is considered to be fair. Removal of the brush from the downstream abutments over a distance of about 20 feet from the toe would be required to facilitate adequate visual inspection of these areas.

4.3 Maintenance of Operating Facilities. The water company declined to operate the blow-off valve to demonstrate its functional condition without compensation for its operation and compensation for any damage that would result due to its operation. Therefore, the operative condition of the drawdown facilities could not be assessed. In general, the equipment appears to be in fair condition.

4.4 Warning System in Effect. There is no formal flood warning system in effect. The dam is maintained by the personnel of the water company, operating from the company office in Altoona approximately ten miles from the dam site. The water company personnel reported that the dam is visited during severe weather conditions. No communication facilities are available at the dam site.

4.5 Evaluation. The operational condition of the dam is considered to be poor. The operative condition of the drawdown facility was not observed. The dam is accessible from a county road under all weather conditions for inspection and emergency action purposes.

SECTION 5  
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Tipton Dam has a watershed area of 9.6 square miles and impounds a reservoir with a surface area of 46 acres. A 150-foot-wide spillway flowing over the dam constitutes the flood discharge system for the impoundment. The spillway crest is located at an elevation four feet below the crest of the dam. The maximum discharge capacity of the overflow section of the dam is estimated to be 3700 cfs with no freeboard.

b. Experience Data. As previously stated, Tipton Dam is classified to be an "intermediate" size dam in the "high" hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass full probable maximum flood (PMF).

The adequacy of the overflow was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers (Appendix D). Based on this analysis procedure, it was determined that the PMF inflow hydrograph would have a peak of 23,000 cfs and a total volume of approximately 13,300 acre-feet. These values are greater than the overflow section capacity (3700 cfs) and the reservoir flood storage volume (184 acre-feet). Therefore, the overflow section is not capable of passing the PMF flow without overtopping the entire structure. Further analysis, according to the procedure, indicated that the overflow section can pass a maximum flow of approximately 18 percent of the PMF without overtopping. In the event of full PMF, the depth of overtopping over the entire dam was determined to be approximately 4.6 feet.

c. Visual Observations. On the date of inspection, no conditions were observed which would indicate that the spillway of the dam could not operate satisfactorily in the event of a major flood.

d. Overtopping Potential. As stated above, the dam will be overtopped during a flood whose magnitude exceeds 18 percent PMF. However, because it is a masonry dam, overtopping is not considered to significantly affect the overall stability of the dam.

e. Spillway Adequacy. Based on the observations stated above, flood discharge capacity of the dam is considered to be adequate.

## SECTION 6 STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

a. Visual Observations. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam and none were reported in the past.

b. Design and Construction Data. It appears that the original design incorporated stability analyses for the dam. Visual observations and past inspection reports indicate that the structure was constructed with reasonable care.

As a part of this inspection, the stability of the dam was reevaluated by an independent approximate analysis. The preliminary stability analysis (Appendix D) indicated that the factor of safety against overturning is 2.0 when pool level is at the spillway crest level of the dam and 1.7 when the dam is overtopped by 4.6 feet. The analysis was based on hydrostatic uplift pressure assumption of zero at the downstream toe and two-thirds of the total head at the upstream toe. Sliding shear stresses for the two loading conditions were conservatively determined to be 21 and 25 psi, respectively. To simplify the problem, passive resistance at the toe and shear strength of the concrete cutoff wall was neglected. The sliding shear stresses are within the range of allowable shear strength of sandstones on which the dam is reported to be founded. This analysis indicates that the dam is stable, concurring with the results of an analysis noted in the 1923 inspection report.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. There have been no reported modifications to the original design that would affect the structural stability of the structure.

## SECTION 7 ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

### 7.1 Dam Assessment

a. Assessment. The visual observations and review of available information indicate that Tipton Dam is in good condition. It appears that the structure was built with reasonable care with the means available at the time of construction. The capacity of the overflow section was found to be inadequate (18 percent PMF) relative to the spillway capacity criteria established by the Corps of Engineers. However, the stability analysis indicates that the dam would be stable even if the entire crest is overtopped by 4.6 feet during PMF. Therefore, flood discharge capacity of the dam is considered to be adequate.

b. Adequacy of Information. Although the available design information is very limited, a reasonable assessment of the dam can be made on visual observations, reports of past observations, and previous experience of the inspectors.

c. Urgency. The recommendations suggested below should be implemented immediately or on a continuing basis, as noted.

d. Necessity for Further Investigation. The condition of the dam does not require more detailed investigation at this time.

### 7.2 Recommendations/Remedial Measures

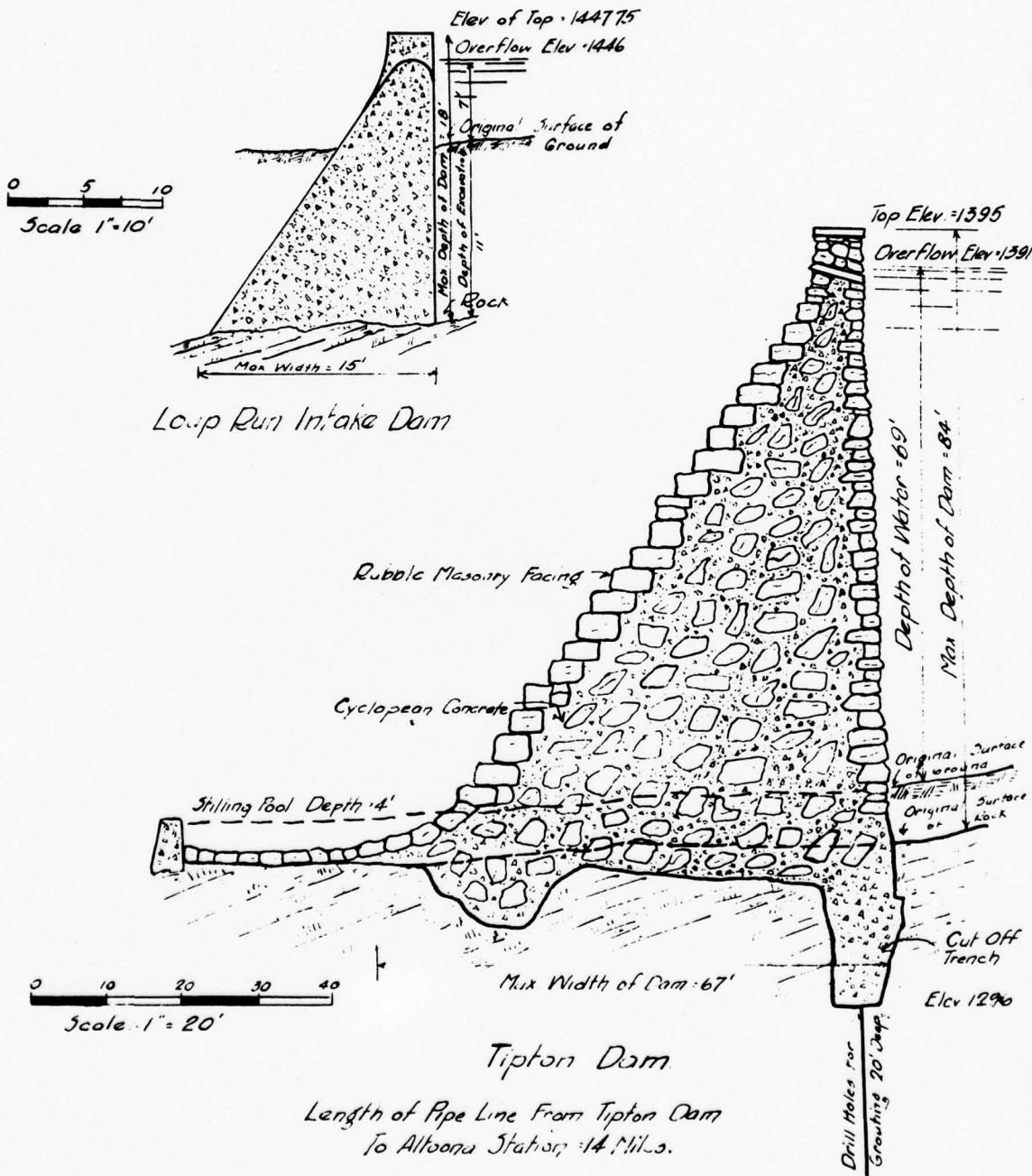
1. It is recommended that the owner immediately evaluate the operational condition of the reservoir blow-off valve and perform necessary maintenance.
2. Spalling concrete capping blocks and plunge pool side walls should be repaired as soon as practicable.
3. Because the dam may overtop during unusually high runoff, it is recommended that during such periods the owner should provide around-the-clock surveillance for early detection of problems, such as erosion of the abutments.
4. It is recommended that brush and trees on the abutments should be cleared over a distance of approximately 20 feet from the dam to permit adequate future visual inspection of the abutment areas.

5. It is recommended that the owner develop a formal warning system to alert the downstream residents in the event of emergencies.
6. It is recommended that the owner be advised that the dam and appurtenant structures should be inspected regularly by the dam tender and properly maintained.

PLATES

DRAWN BY	D.J.D.	CHECKED BY	J.H.P.	DRAWING
BY	7-21-78	APPROVED BY	B.E.	8-23-78
				NUMBER 78-114-B100

# OPENING OF



Dec 23, 1924

# TIPTON DAM

## THE TIPTON WATER COMPANY

W.B. McCaleb, General Superintendent.  
Charles Haydock, Engineer for The Water Co.  
J.W. Ledoux, Consulting Engineer  
Crosby Tappan, Resident Engineer.

### CONTRACTORS

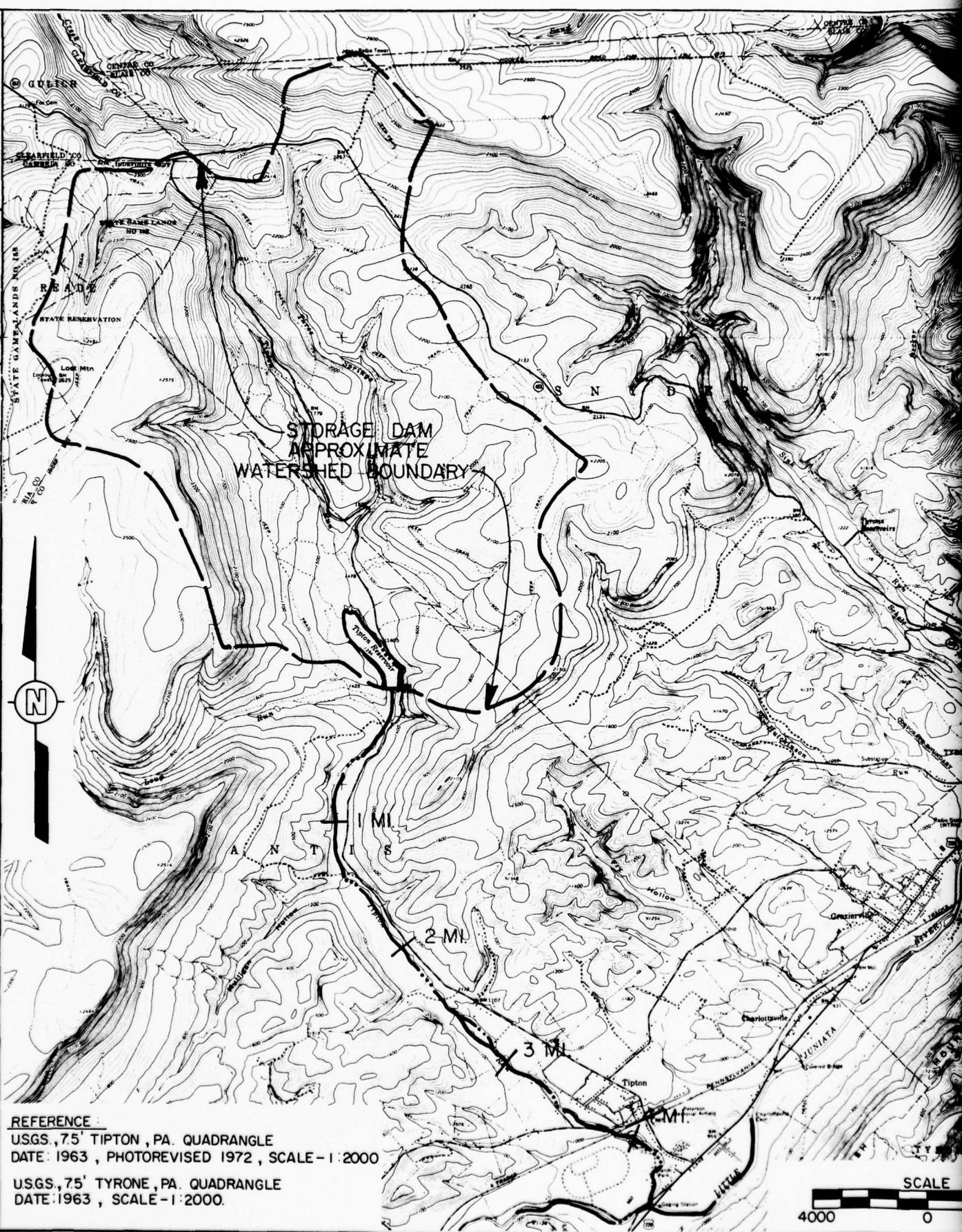
AL ANDERSON & BROS Inc Altoona Pa.  
Elmer Clark Superintendent

Preliminary Work Started May 29, 1923  
Work On Main Dam Started July 29, 1923  
Main Dam Completed October 29, 1924.  
Length of Dam at Top = 555 feet  
Maximum Height of Dam = 84' feet  
Width of Dam at Top = 7 feet  
Maximum Width of Dam = 67 feet  
Length of Spillway = 150 feet  
Greatest Depth of Excavation Below Ground = 30 feet.  
Total Amount of Face Masonry = 4860 Cubic Yards  
Total Amount of Cyclopean Concrete = 30,771 Cubic Yards  
Total Amount of Earth Excavation = 18,280 Cubic Yards  
Total Amount of Rock Excavation = 7,363 Cubic Yards  
Total Amount of Rock Excavated for Cut Off Trench = 1342 Cubic Yards  
Total Depth of Drill Holes for Grouting = 21.58 Feet  
Total Amount of Cement Used in Grouting = 272 Barrels  
Total Amount of Cement Used on Entire Project = 40,000 Barrels  
Capacity of Reservoir = 365,000,000 gallons.  
Area Flooded = 55 Acres  
Depth of Water = 69 feet  
Length of Reservoir = 2640 feet  
Drainage Area = 8.2 Square Miles  
Size of Waste Pipe = 36 inches  
Size of Outlet Pipe = 24 inches  
Number of Outlets at Different Elevations = 5  
Elevation of Spillway Above Passenger Tanks At Alterna Station = 102'  
Length of 20" Concrete Pipe From Tipton Dam to Loup Run Intake Dam = 4300'  
Drainage Area of Loup Run = 32 1/2 square Miles  
Depth of Water in Loup Run Dam = 7 feet  
Maximum Number of Men Employed = 175

PLATE I

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	J.H.P.	DRAWING NUMBER	78-114-B120
BY	7-25-78	APPROVED BY	B.C.		
				82378	82378



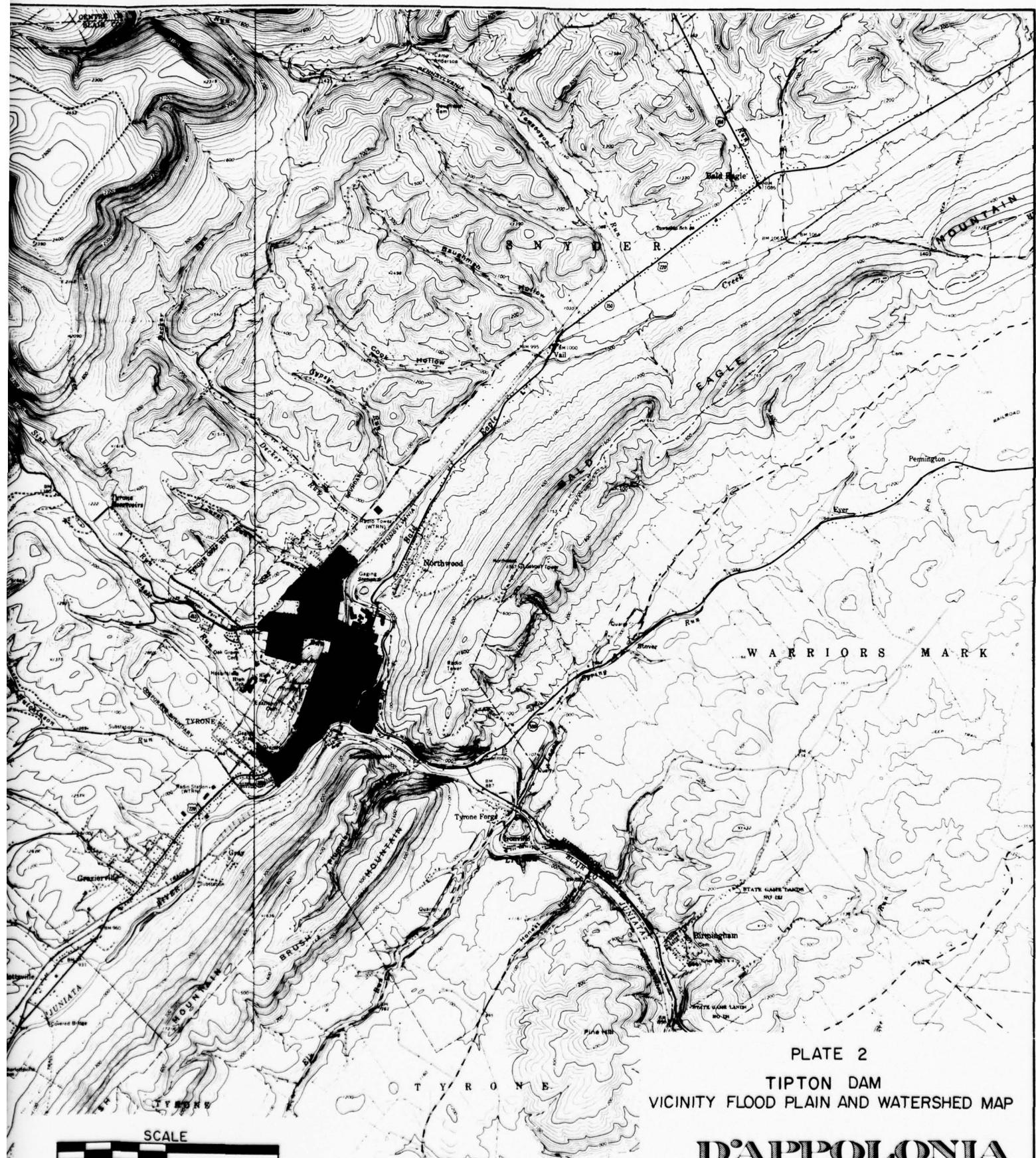
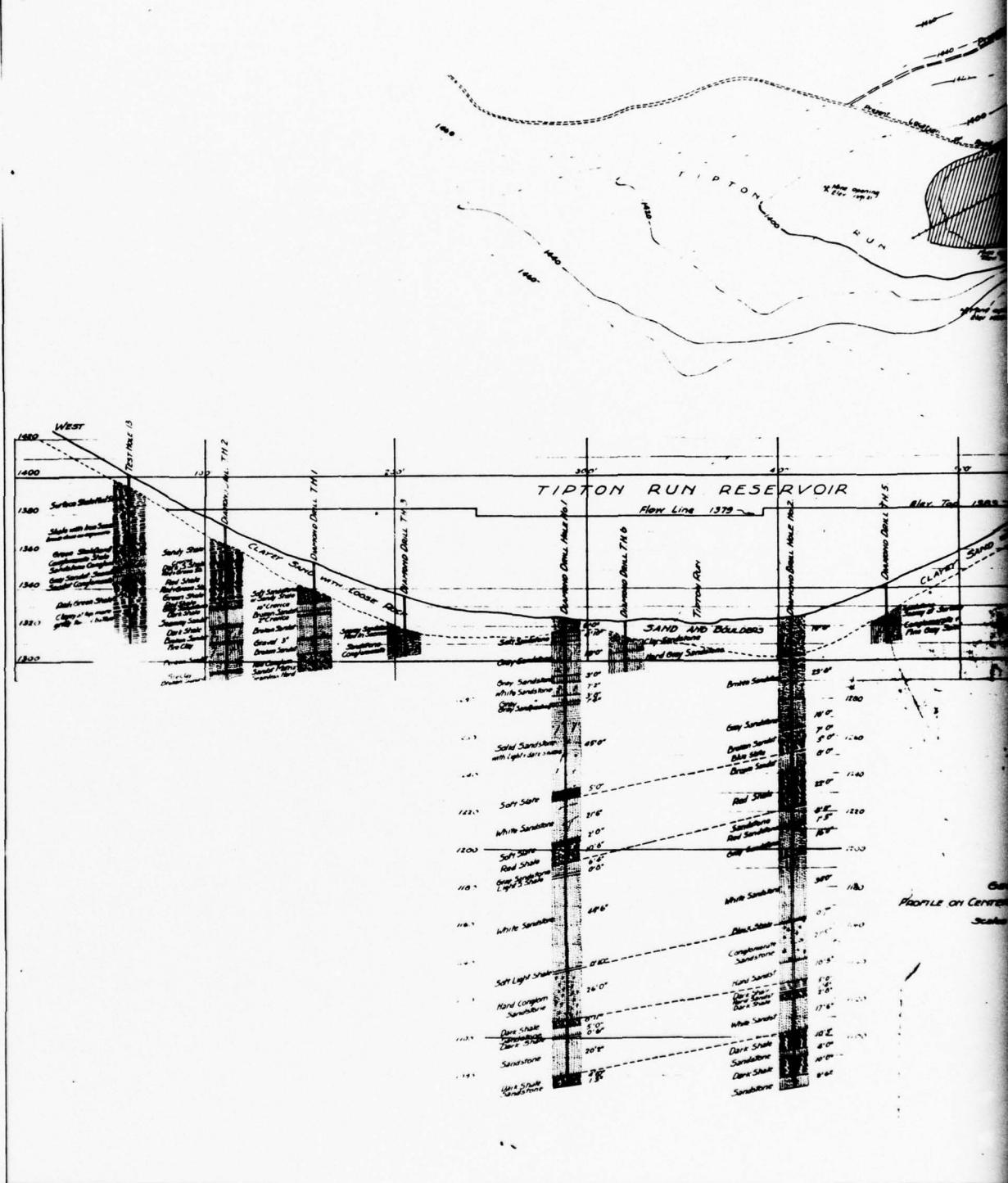


PLATE 2  
TIPTON DAM  
VICINITY FLOOD PLAIN AND WATERSHED MAP

D'APPOLONIA

DRAWN BY	D. J. D.	CHECKED BY	JAD	DRAWING NUMBER	7-23-78
			BC		78-14-B102
APPROVED BY					8-23-78



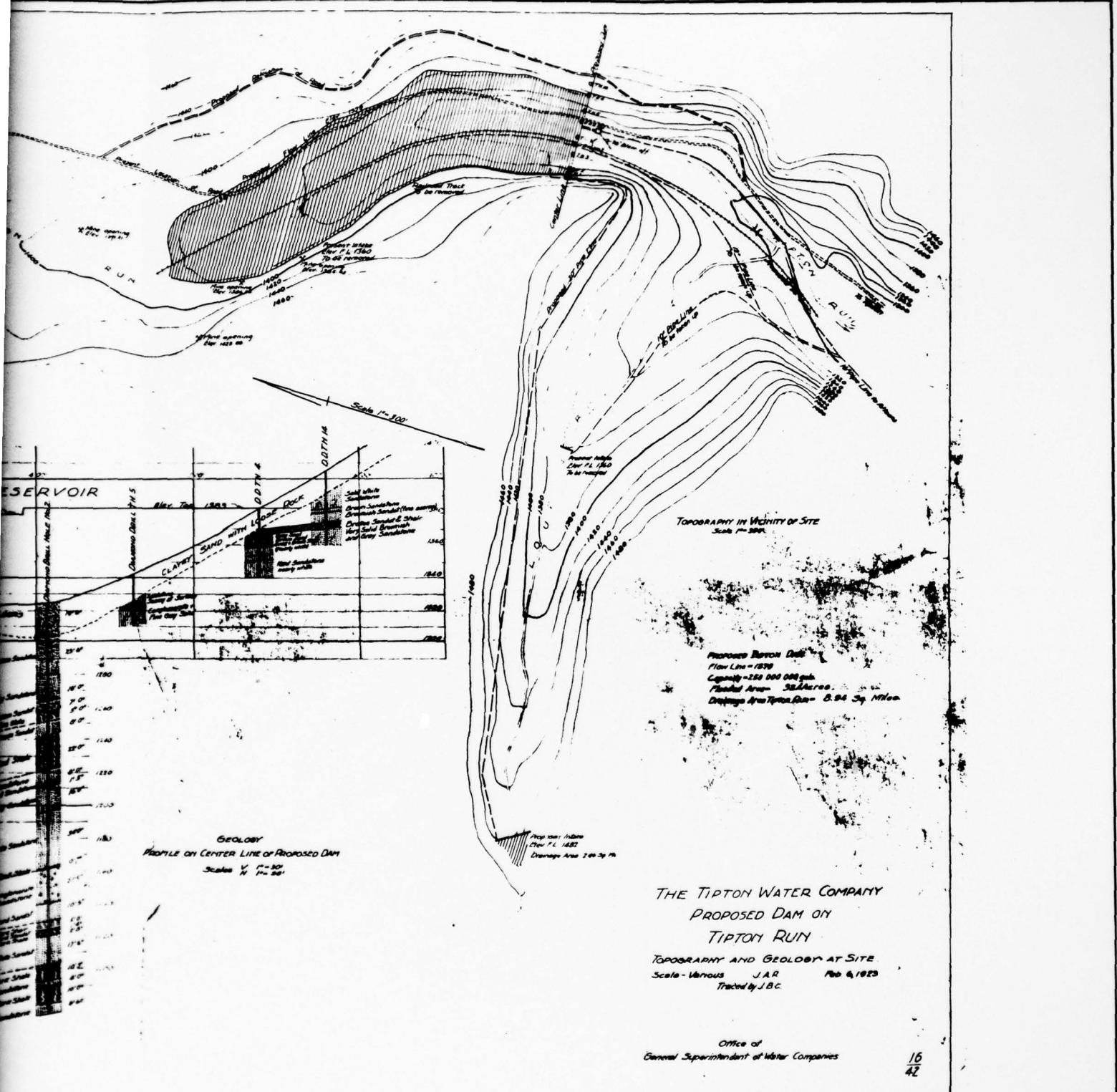
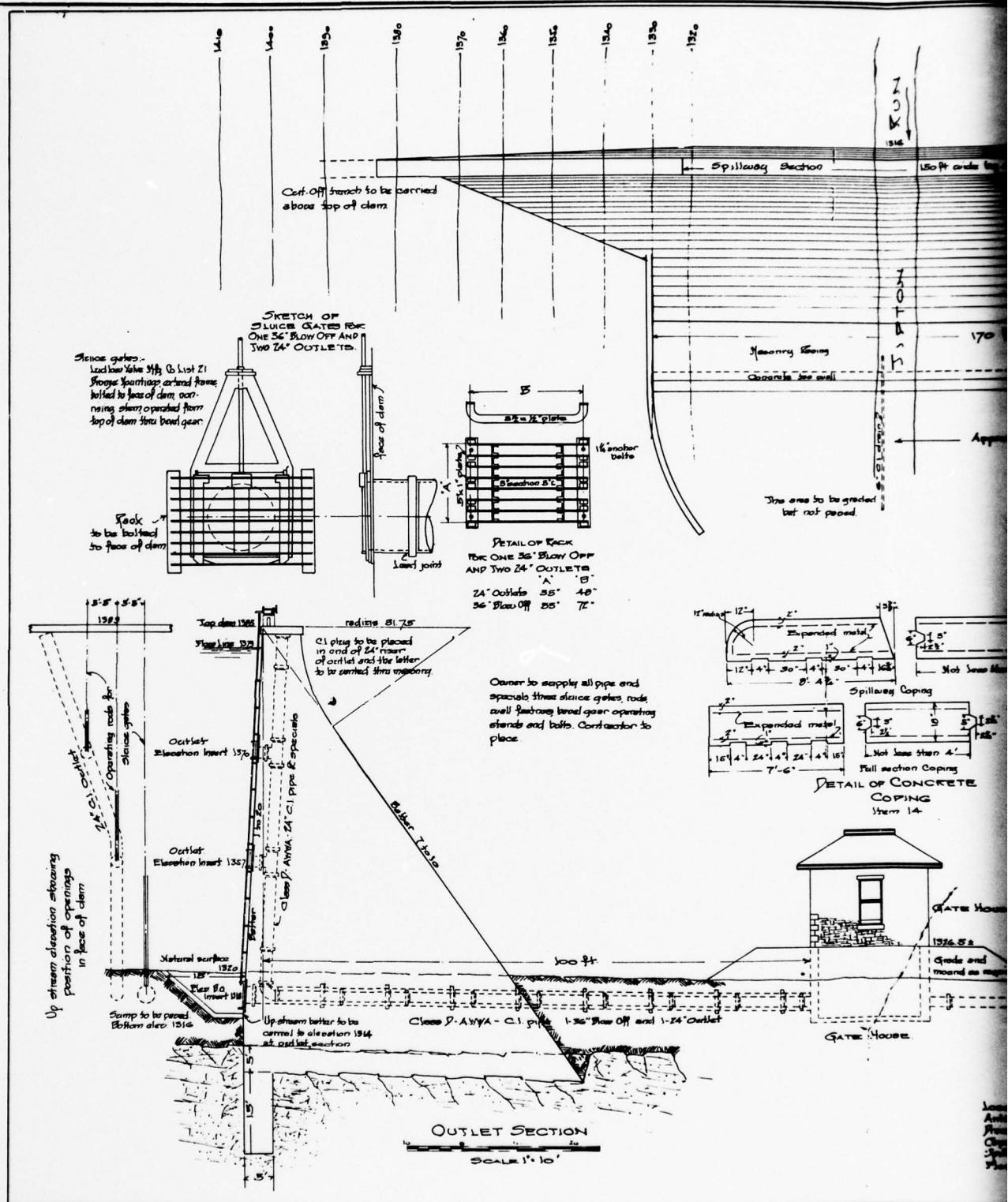


PLATE 3

D'APPOLONIA

Q

DRAWN BY D.J.D. CHECKED BY ✓HP DRAWING  
7-21-78 APPROVED BY 85 NUMBER 78-114-B101



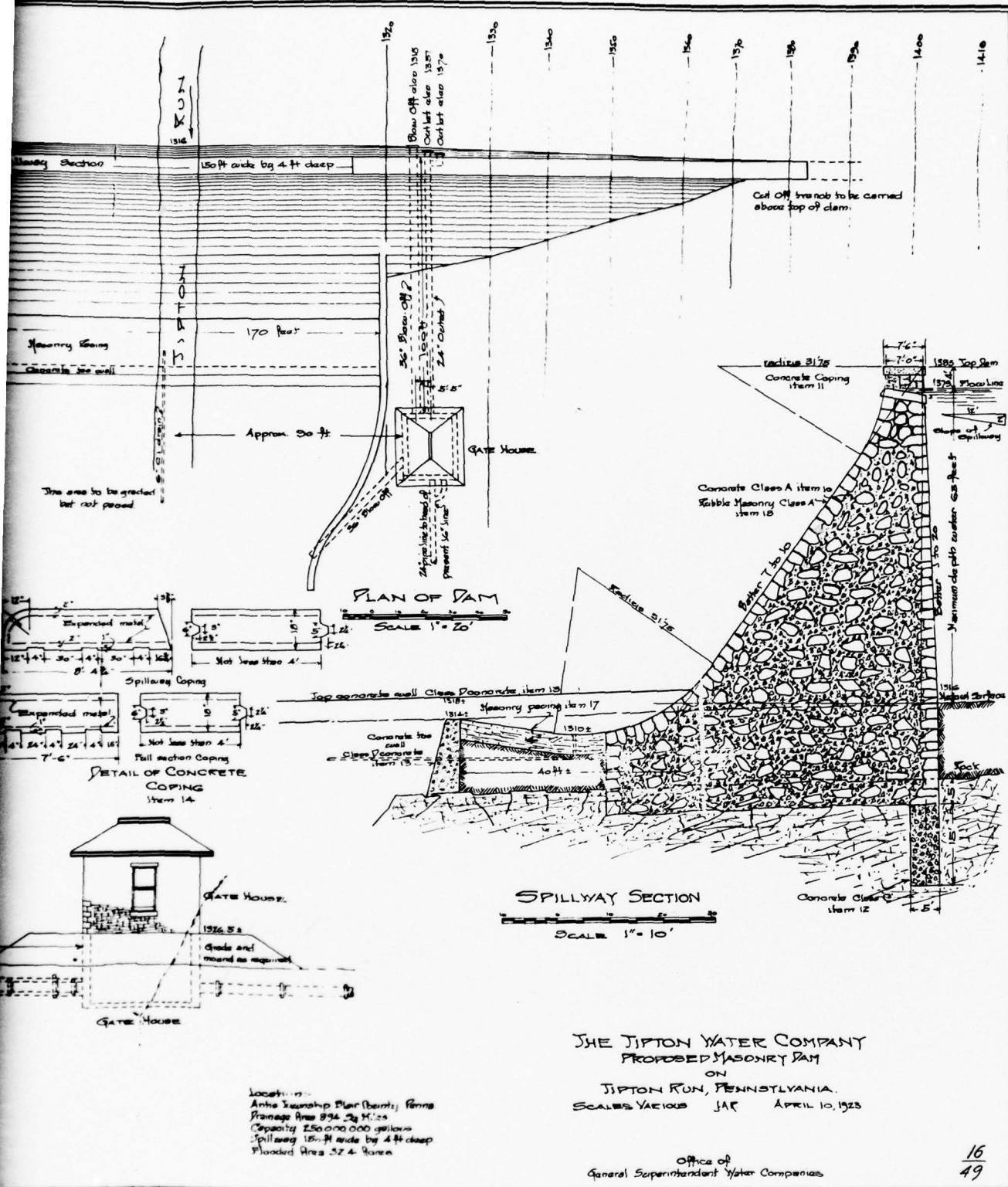
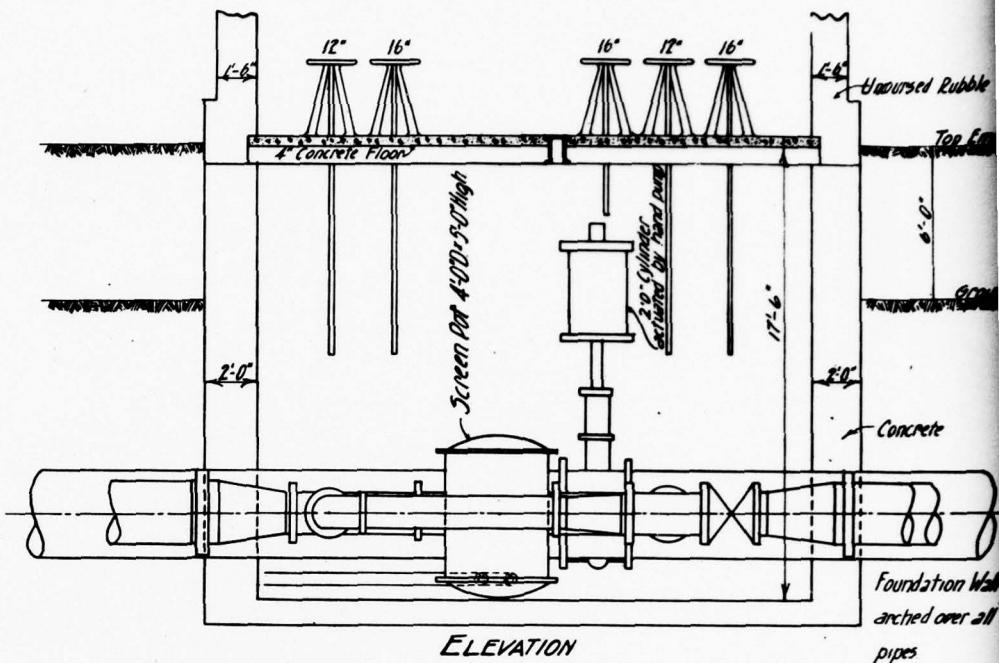


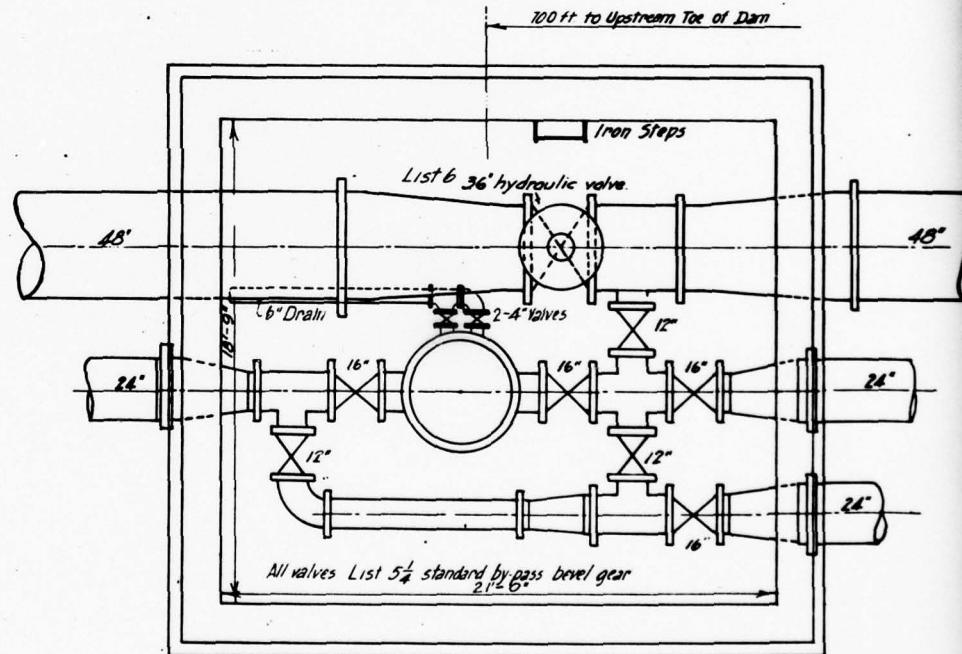
PLATE 4

D'APPOLONIA

DRAWN D.J.D. CHECKED BY JHP DRAWING 8-23-78  
BY 7-21-78 APPROVED BY BE NUMBER 78-114-B99

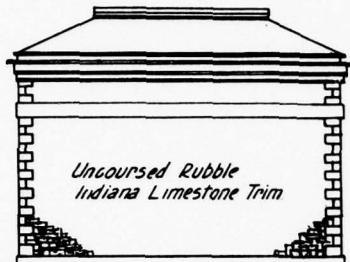
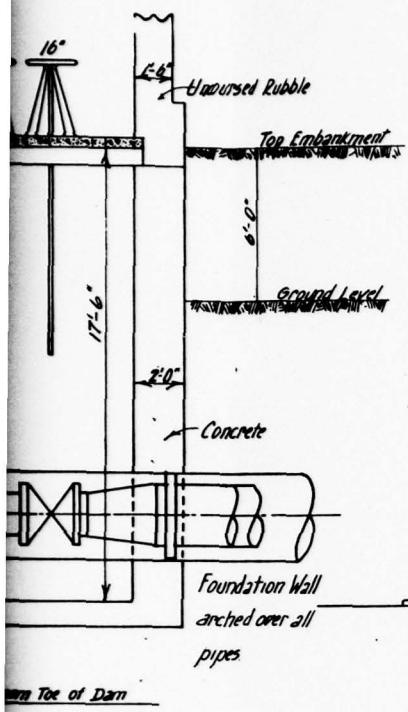


ELEVATION

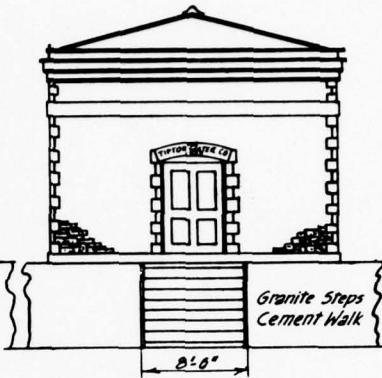


PLAN OF VALVE PIT

See Plan <sup>16</sup> <sub>42</sub> General Layout  
" " <sup>16</sup> <sub>43</sub> Details of Embankment & Spillway

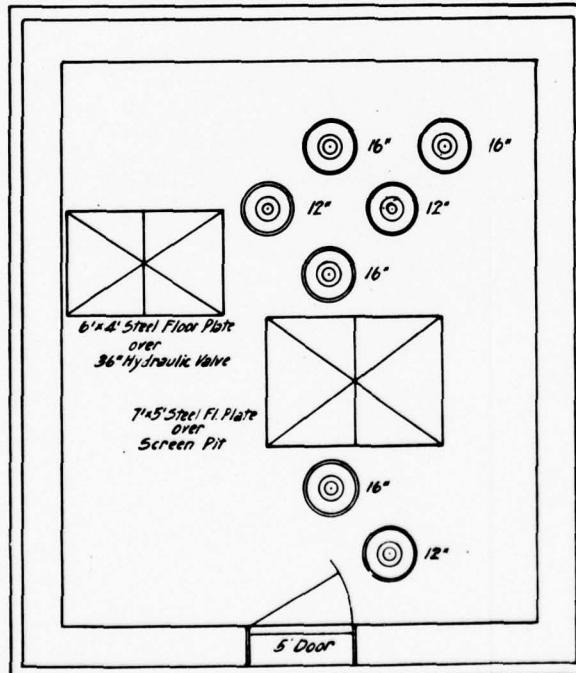
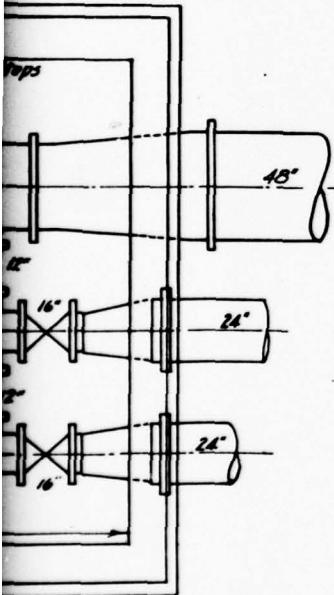


Slate Shingles  
Copper Flashing, Ridge,  
Lave, Trim & Spouts



SIDE ELEVATION

FRONT ELEVATION



FLOOR PLAN

THE TIPTON WATER CO.  
PROPOSED EARTHEN DAM  
ON  
TIPTON RESERVOIR  
DETAILS OF GATE HOUSE

Scale 1"-4'  
Scale 1"-8' J.B.C. Oct 19, 1922

OFFICE OF  
GENERAL SUPERINTENDANT  
WATER COMPANIES

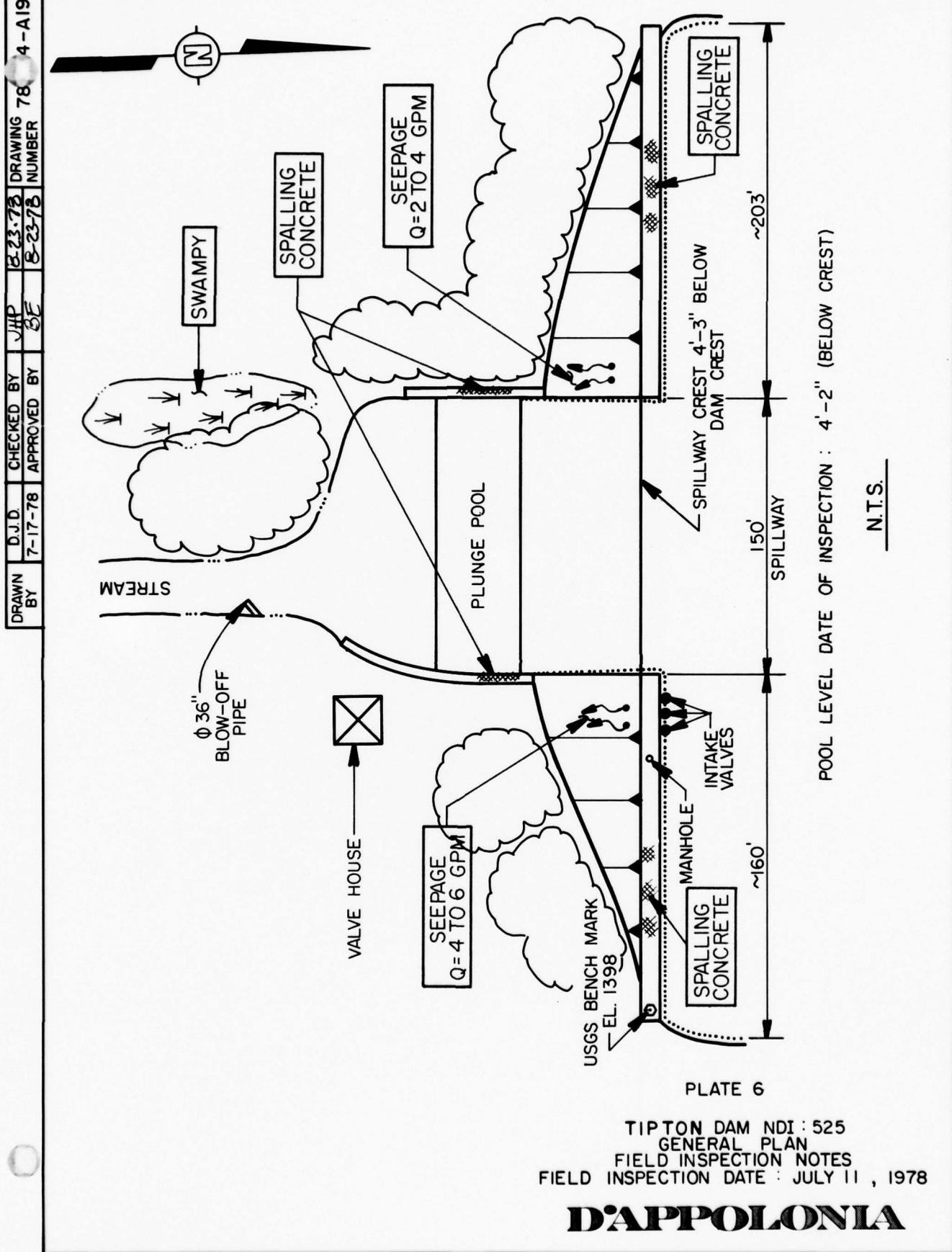
19  
36

PLATE 5

D'APPOLONIA

2

DRAWN BY	D.J.D.	CHECKED BY	J.H.P.	B-23-73	DRAWING 78
				B-23-73	NUMBER 4-A19



TIPTON DAM NDI: 525  
GENERAL PLAN  
FIELD INSPECTION NOTES  
FIELD INSPECTION DATE: JULY 11, 1978

**D'APPOLONIA**

APPENDIX A  
CHECKLIST  
VISUAL INSPECTION  
PHASE I

APPENDIX B  
CHECKLIST  
ENGINEERING DATA, DESIGN,  
CONSTRUCTION, OPERATION  
PHASE I

**APPENDIX C**  
**PHOTOGRAPHS**

APPENDIX A  
CHECKLIST  
VISUAL INSPECTION  
PHASE I

CHECKLIST  
VISUAL INSPECTION  
PHASE 1

NAME OF DAM TIPTON DAM COUNTY BLAIR STATE PA ID# NDT: 525  
TYPE OF DAM MASONRY HAZARD CATEGORY HIGH PER: 7-67

DATE(S) INSPECTION JULY 11, 1970 WEATHER SUNNY TEMPERATURE 80°

POOL ELEVATION AT TIME OF INSPECTION 1394 M.S.L. TAILWATER AT TIME OF INSPECTION 1325 ± M.S.L.

INSPECTION PERSONNEL:

BILGIN EREL REGULAR INSPECTOR: ELIS UAPPALANDIA  
WAN-TAR CHAI ASSISTANT: L.D. ANDERSEN

JAMES PELLOT

BILGIN EREL RECORDER

NAME OF DAM Tipton Dam  
ID# NDI: 525 DEP: 7-67

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
		REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	MASONRY DAM	N/A
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE		N/A
SLoughing or Erosion of Embankment and Abutment Slopes		N/A
Vertical and Horizontal Alignment of the Crest		N/A
RIPRAP FAILURES		N/A.

VISUAL INSPECTION		NAME OF DAM <u>TIPPOU DAM</u>	ID# NDI : 525 DEC:7-67
PHASE I		REMARKS OR RECOMMENDATION:	
EMBANKMENT		OBSERVATIONS:	
VISUAL EXAMINATION OF			
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	(MASSORY DAM)	N/A.	
ANY NOTICEABLE SEEPAGE		N/A.	
STAFF GAGE AND RECORDER		NONE	
DRAINS		NONE	

VISUAL INSPECTION  
PHASE I  
CONCRETE/MASONRY DAMS

NAME OF DAM **TIPPTON DAM**  
IN# NDI: 5CS DER: 7-67

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	LEFT SIDE OF SPILLWAY APPL + 10 FT. BELOW CREST LEVEL SEEPS THROUGH JOINTS. TOTAL FLOW $\approx$ 4 TO 6 GPM.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	NO VISUAL SIGNS OF DISTRESS. NO SEE PAGE ON ABUTMENTS.	
DRAINS	NONE FOUND.	
WATER PASSAGES	NONE	
FOUNDATION	NO PERCEIVABLE SIGN OF DISTRESS.	

VISUAL INSPECTION PHASE I CONCRETE/MASONRY DAMS		NAME OF DAM <u>TIPTON LAM</u> IN# NDI: 525 SEP: 7-67	REMARKS OR RECOMMENDATIONS:
VISUAL EXAMINATION OF	OBSERVATIONS		
SURFACE CRACKS CONCRETE SURFACES	SOME CREST COURSES BLOCKS SWELLING.		
STRUCTURAL CRACKING	NONE		
VERTICAL AND HORIZONTAL ALIGNMENT	NO PERCEIVABLE MISALIGNMENT.		
MONOLITH JOINTS	NONE		
CONSTRUCTION JOINTS	NONE		
STAFF GAGE OF RECORDER:	NONE		

VISUAL INSPECTION		NAME OF DAM <u>TIPTON DAM</u>	ID# NDI:525 DRI:7-67
VISUAL EXAMINATION OF :	OBSERVATIONS	REMARKS OR RECOMMENDATIONS	
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OUTLET PIPE IS CAST IRON ONLY OUTLET END IS VISIBLE CONDUIT NOT ASSESSABLE.	OVERALL CONDITION OF THE OUTLET PIPE IS NOT ASSESSABLE.	
INTAKE STRUCTURE	SUBMERGED . NOT VISIBLE .		
OUTLET STRUCTURE	NO OUTLET STRUCTURE . PIPE WOULD DIRECTLY DISCHARGE INTO THE STREAM .		
OUTLET CHANNEL	NO OUTLET CHANNEL .		
EMERGENCY GATE	36 - INCH CAST IRON PIPE . OUTLET VALVE WAS NOT OPERATED . WATER COMPANY DECLINED TO OPERATE THE VALVE WITHOUT COMPENSATION FOR SERVICES PLUS ANY DAMAGES CAUSED BY THE OPERATION )		

VISUAL INSPECTION		NAME OF DAM <u>TIPTON DAM</u>	ID# NDE : 525 DER : 7-67
VISUAL EXAMINATION OF		REMARKS OR RECOMMENDATIONS	
OBSERVATIONS			
CONCRETE WEIR	SUBMERGED. VISIBLE PORTIONS ON EACH SIDE GOOD CONDITION.		
APPROACH CHANNEL	LAKE (NO APPROACH CHANNEL)		
DISCHARGE CHANNEL	WATER FLOWS OVER THE FACE OF THE DAM INTO A PLUNGE POOL.		
BRIDGE AND PIERS	NONE		

VISUAL INSPECTION		NAME OF DAM <u>TIPTON DAM</u>	IM. ALT.: <u>5.55</u>	DEP: <u>7-67</u>
PHASE I				
GATED SPILLWAY				
OBSERVATIONS		REMARKS OR RECOMMENDATIONS		
VISUAL EXAMINATION OF				
CONCRETE SILL	NO GATED SPILLWAY			
	., N/A			
APPROACH CHANNEL		N/A		
DISCHARGE CHANNEL		N/A		
BRIDGE PIERS		N/A		
GATES AND OPERATION EQUIPMENT		N/A		

VISUAL INSPECTION		NAME OF DAM <u>Tipton Dam</u>	
PHASE 1		ID# ADT: 525 VER: 7-67	
INSTRUMENTATION		REMARKS OR RECOMMENDATIONS	
VISUAL EXAMINATION OF	OBSERVATIONS		
MONUMENTATION/SURVEYS	NONE		
OBSERVATION WELLS	NONE		
WEIRS	NONE		
PIEZOMETERS	NONE		
OTHER	NONE		

VISUAL INSPECTION		NAME OF DAM <u>TIPPOU DAM</u>	
		ID# NDI: S25 DEC: 7-67	
PHASE 1		REMARKS OR RECOMMENDATIONS	
RESERVOIR			
OBSERVATIONS			
VISUAL EXAMINATION OF SLOPES	WOODED, NO SIGNS OF EROSION.		
SEDIMENTATION	UNKNOWN		

VISUAL INSPECTION		NAME OF DAM <u>TIPTON DAM</u>	
PHASE I		ID# NDE : 525 DEC: 7-67	
DOWNSTREAM CHANNEL			
VISUAL EXAMINATION OF CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	OBSERVATIONS	REMARKS OR RECOMMENDATIONS	
FIRST 2-MILES STEEP & ROCK CHANNEL. REST OF IT'S COARSE STREAM FLOWS ON A MILDER SLOPE THROUGH SUBURBAN AREA. THERE ARE SEVERAL SMALL BRIDES IN THIS REACH. STREAM CROSSES PENN. CENTRAL R.R. NEAR TIPTON.			
SLOPES	TYPICAL NATURAL STREAM CHANNEL NO NOTICABLE EROSION.		
APPROXIMATE NUMBER OF HOMES AND POPULATION	ONE OR 100 HOMES WITHIN MAIN IMPACT AREA OF A FLOOD IN THE EVENT OF DAM FAILURE POPULATION $\approx$ 400 ~ 500		

APPENDIX B  
CHECKLIST  
ENGINEERING DATA, DESIGN,  
CONSTRUCTION, OPERATION  
PHASE I

CHECKLIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE I

NAME OF DAM TIPTON DAM  
 ID# NDI : 525 DER : 767

ITEM	AS-BUILT DRAWINGS	REMARKS
REGIONAL VICINITY MAP	SEE PLATE 2	
CONSTRUCTION HISTORY		DESIGN AND CONSTRUCTED BY TIPTON WATER COMPANY, A SUBSIDIARY OF THE PENNSYLVANIA CALIFORNIA CO. CONSTRUCTION COMPLETED IN 1924
TYPICAL SECTIONS OF DAM	SEE PLATE 1	
OUTLETS - PLAN	SEE PLATES 4 & 5	<ul style="list-style-type: none"> <li>- DETAILS</li> <li>- CONSTRAINTS</li> <li>- DISCHARGE RATINGS</li> </ul>

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CHECKLIST		NAME OF DAM	TIPPMU	DAM
ENGINEERING DATA		1DM	NDI : 525	DEC: 7-67
ITEM	REMARKS			
RAINFALL/RESERVOIR RECORDS	NOT RECORDED.			
DESIGN REPORTS	NO FORMAL DESIGN REPORT AVAILABLE. VARIOUS STATE REPORTS DESCRIBE THE DESIGN			
GEOLOGY REPORTS	NO FORMAL GEOLOGY REPORT. SEE PLATE 3 FOR GEOLGICAL CROSS SECTION OF THE DAM SITE.			
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NOT AVAILABLE.			
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	SEE PLATE 3			

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CHECKLIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE I

NAME OF DAM TIPTON DAM  
 ID# SDS DER: 7-67

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED.
BORROW SOURCES	IT IS REPORTED THAT ROCKS FOR THE BOULDER CONCRETE WAS QUARRIED FROM AN AREA 300 TO 400 FT DOWNSTREAM FROM THE DAM
MONITORING SYSTEMS	NONE
MODIFICATIONS	NONE REPORTED.
HIGH POOL RECORDS	NOT EXCERDED. (A STATE REPORT INDICATES THAT DURING 1972 FLOOD FLOW OVER THE SPILLWAY STREAM WAS 2 FT DEEP)

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CHECKLIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE I

NAME OF DAM TIPTON DAM  
 ID# NDI : 525 DER : 7-67

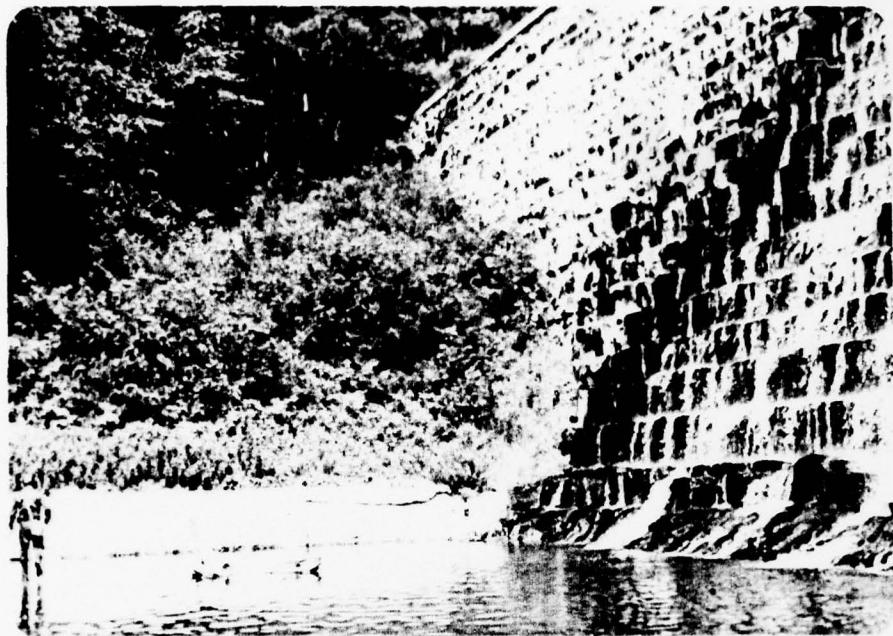
ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE OTHER THAN PERIODIC STATE INSPECTIONS REPORTS.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED.
Maintenance OPERATION RECORDS	NOT AVAILABLE.
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATE 4
OPERATING EQUIPMENT PLANS AND DETAILS	SEE PLATES 4 & 5

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APPENDIX C  
PHOTOGRAPHS

LIST OF PHOTOGRAPHS  
TIPTON DAM  
NDI I.D. No. 525  
JULY 11, 1978

<u>PHOTOGRAPH NO.</u>	<u>DESCRIPTION</u>
1	Right abutment.
2	Left abutment.
3	Crest (looking east).
4	Spillway crest (looking east).
5	Spillway plunge pool.
6	Intake controls on crest.
7	Blow-off pipe (note valve house in righthand corner).
8	Minor seepage through the dam (left of spillway).
9	Bridge on Penn-Central Railroad.
10	Bridge on Route 220 (confluence of Tipton Run and Little Juniata River, Little Juniata River merges from the right).



Photograph No. 1

Right abutment.

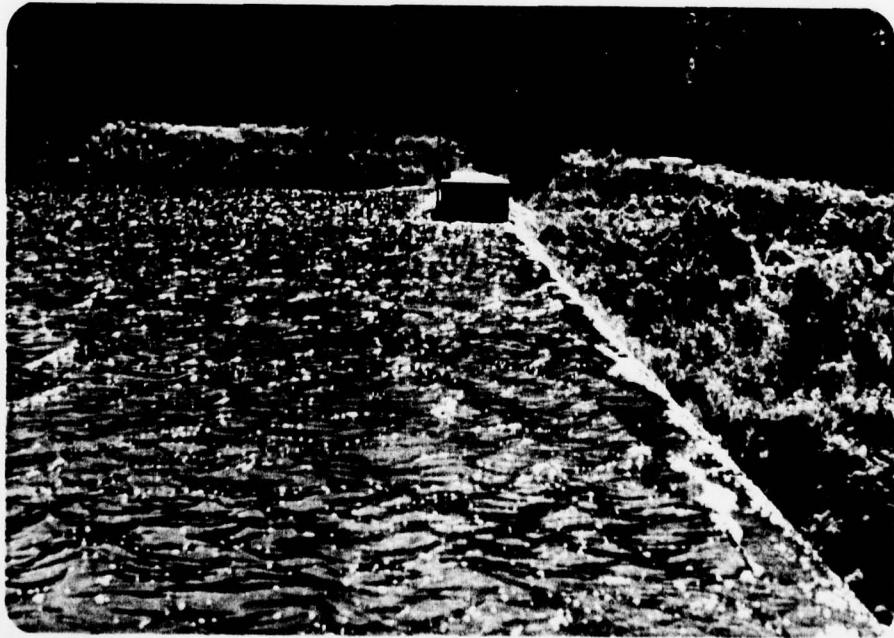


Photograph No. 2

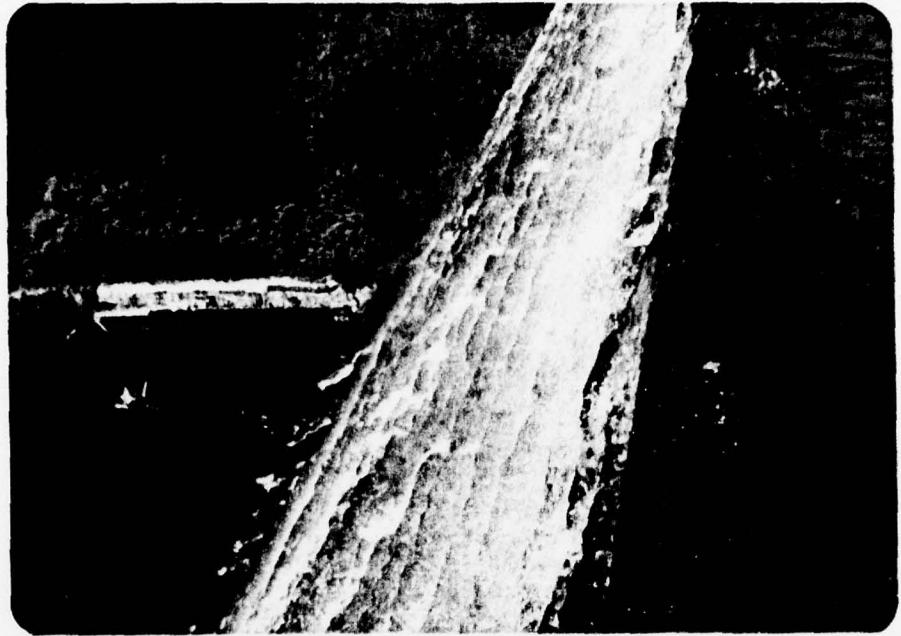
Left abutment.



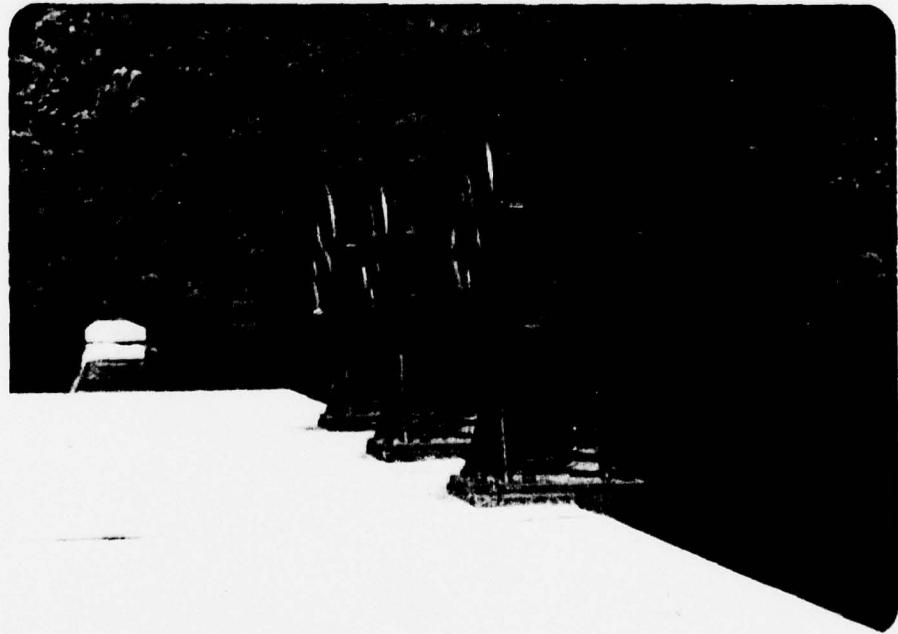
Photograph No. 3  
Crest (looking east).



Photograph No. 4  
Spillway crest (looking east).



Photograph No. 5  
Spillway plunge pool.



Photograph No. 6  
Intake controls on crest.



Photograph No. 7

Blow-off pipe (note valve house in righthand corner).

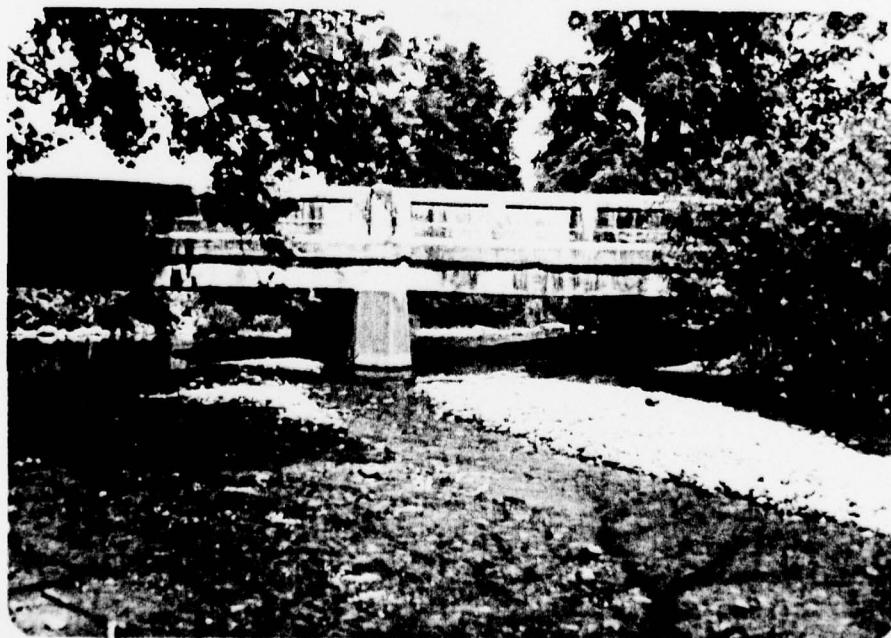


Photograph No. 8

Minor seepage through the dam (left of spillway).



Photograph No. 9  
Bridge on Penn-Central Railroad.



Photograph No. 10  
Bridge on Route 220 (confluence of Tipton Run and Little Juniata River, Little Juniata River merges from the right).

**APPENDIX D**  
**CALCULATIONS**

**APPENDIX E**  
**REGIONAL GEOLOGY**

APPENDIX D  
CALCULATIONS

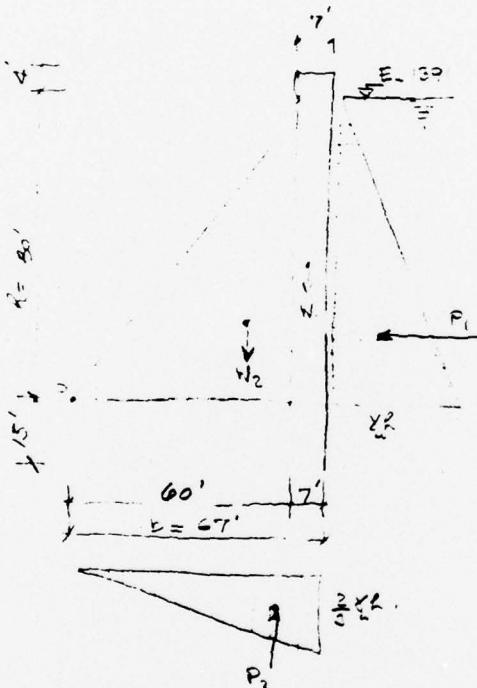
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**D'AMPIODONLA**  
CONSULTING ENGINEERS, INC.

By B.E Date 8-3-78 Subject TIPTON DAM  
Chkd. By JK Date 8-22-78 STABILITY ANALYSIS

Sheet No. 1 of 2  
Proj. No. 18-114-1B

STABILITY OF DAM @ NORMAL POOL LEVEL.



SHEETLENG MOMENTS ABOUT PT. 0.

$$\begin{aligned}
 &= \frac{1}{2} \times 7 \times 3^2 + \frac{1}{3} \left( \frac{2}{3} \times 30 + \frac{7}{3} \times 7 \right) \\
 &= \frac{1}{6} \times 7^2 + \frac{1}{9} \times 21 \times 7^2 \\
 &= \frac{1}{6} \times 62 \times 30 + \frac{2}{9} \times 62 \times 30 + 7^2 \\
 &= 5.3 \times 10^6 + 5.0 \times 10^6 \\
 M_o &= 0.3 \times 10^6 \text{ ft-lb}
 \end{aligned}$$

RESISTING MOMENTS ABOUT PT. 0.

$$\begin{aligned}
 W_1 &= 99 \times 7 \times 150 = 1.0 \times 10^6 \\
 W_2 &= \frac{1}{2} \times 60 \times 30 \times 150 = .36 \times 10^6
 \end{aligned}$$

$$\begin{aligned}
 N_R &= 0.10 \times 10^6 \times (60 + 3.5) \\
 &\quad + 0.36 \times 10^6 \times \frac{2}{3} \times 60 \\
 &= 6.6 \times 10^6 + 14.4 \times 10^6 \\
 &= 21.0 \times 10^6 \text{ lb-ft}
 \end{aligned}$$

$$\text{FACTOR OF SAFETY AGAINST OVER TURNING} = \frac{21.0 \times 10^6}{10.8 \times 10^6} = \underline{\underline{2.0}}$$

FOUNDATION SHEAR STRESS:-

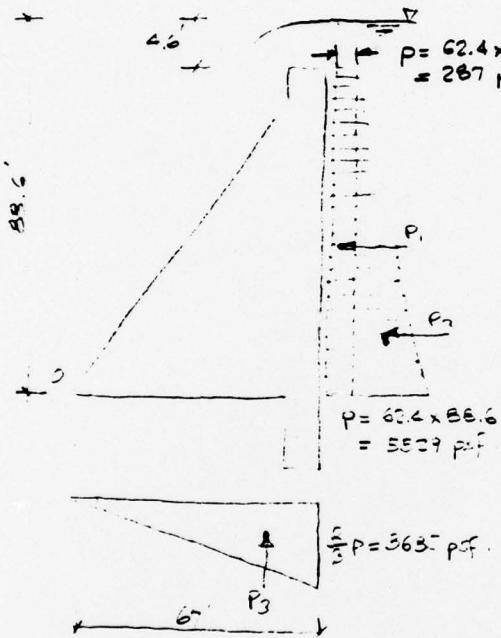
$$\begin{aligned}
 &= \frac{S.F.H}{\text{BASE AREA}} = \frac{P_1}{67 \times 1} = \frac{1}{2} \times 62 \times \frac{30^2}{67} \\
 &= 2960 \text{ psf} = 20.5 \text{ psi}
 \end{aligned}$$

SAT E psf

**D'APIPOLONA**  
CONSULTING ENGINEERS, INC.

By B.E Date 8-3-78 Subject TIPTON DAM Sheet No. 2 of 2  
Chkd. By WIC Date 8-22-78 STABILITY MILESS Proj. No. 78-14-B

STABILITY OF DAM @ POOL 4.6 ABOVE CREST.



HYDROSTATIC FORCE

$$P_1 = 62.4 \times 4.6 \times 84 = 24 \times 10^5 \text{ lb.}$$

$$P_2 = \frac{1}{2} (F_287 - 62.4 \times 4.6) \times 84 \\ = 220 \times 10^5 \text{ lb.}$$

$$P_3 = \frac{1}{2} 3685 \times 67 = 122 \times 10^5 \text{ lb}$$

OVERTURNING MOMENT ABOUT BASE = 270,

$$M_o = \frac{1}{2} 34 \times 24 \times 10^5 \\ + \frac{1}{3} 34 \times 220 \times 10^5 \\ + \frac{2}{3} 67 \times 122 \times 10^5 \\ = 12.7 \times 10^6 \text{ lb-ft.}$$

RESISTING MOMENT FROM PS. 1

$$M_R = 21. \times 10^6 \text{ lb-ft}$$

$$\text{FACTOR OF SAFETY AGAINST OVERTURNING : } \frac{21.0 \times 10^6}{12.7 \times 10^6} \approx \underline{\underline{1.7}} \text{ ok}$$

FOUNDATION SHEAR STRESS .-

$$= \frac{\Sigma F_u}{\text{BASE AREA}} = \frac{24 \times 10^3 + 220 \times 10^3}{67 \times 1} \\ = 3642 \text{ psf} = \underline{\underline{25 \text{ psf}}}$$

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**D'APPOLONIA**  
CONSULTING ENGINEERS, INC.

By WTC Date 7-15-78 Subject TIPTON DAM Sheet No. 1 of 2  
Chkd. By BE Date 7-23-78 Hydrology & Hydraulic Proj. No. 78-114-1B

DAM TIPTON DAM (STORAGE DAM)

WATERSHED AREA, A = 9.6 SQ MILE

THE DAM IS LOCATED IN SUSQUEHANNA BASIN, REGION NO 1.

ACCORDING TO THE CHARTS PROVIDED BY COE BALTIMORE DIST

$$\text{PEAK INFLOW } g = 2400 \text{ cfs/SQ.MILE}$$

$$Q = g \cdot A = 23040 \text{ cfs}$$

$$\text{TOTAL TIME, } T, = 28 \text{ hr} \quad \text{say } 23000 \text{ cfs}$$

$$V_i = \frac{1}{2} (T)(Q)$$

$$= \frac{1}{2} (28 \times 3600) (23000) \left( \frac{1}{43560} \right) \text{ AC-ft}$$

$$= 26612 \text{ AC-ft}$$

WHICH IS EQUAL TO 52" OF RUNOFF, THEREFORE  
REVISE THE RUNOFF TO 26", AND REDUCE T TO  $t_{26}$

$$V_i = \frac{26}{12} (9.6 \times 640) = 13312 \text{ ac-ft}$$

$$\text{say } 13300 \text{ ac-ft}$$

$$t_{26} = \frac{13300 \times 43560}{\frac{1}{2}(3600)(23000)} = 14.0 \text{ hours}$$

RESERVOIR SURCHARGE STORAGE ABOVE SPILLWAY CREST

NORMAL LAKE AREA = 45.9 acre, say 46 acre

$$\text{VOL of SURCHARGE} = 46 \text{ ac} \times (1398 - 1394) = 184 \text{ ac-ft}$$

**DIAPIPOLINA**  
CONSULTING ENGINEERS, INC.

By WR Date 7-15-78 Subject TIPTON DAM Sheet No. 2 of 2  
Chkd. By BE Date 7-23-78 HYDROLOGY & HYDRAULIC Proj. No. 78-114-3

SPILLWAY CAPACITY

TYPE OVERFLOW WEIR  
LENGTH = 150 FT

$$Q_s = C L H^{1.5}$$

$$= (3.1)(150)(4)^{1.5}$$

$$= 3720 \text{ cfs}$$

ACTUALLY THE WHOLE DAM COULD BE A OVERFLOW WEIR.  
assume  $h$  = water depth above Dam Crest

$$Q_s = (3.1)(150)(h+4)^{1.5} + (2.6)(555-150)(h)^{1.5}$$

$$= 465(h+4)^{1.5} + (1053)(h)^{1.5} \text{ cfs}$$

DETERMINE PERCENT OF PMF WITHOUT OVERTOPPING

$$= \left( \frac{3720}{23080} + \frac{184}{13300} \right) 100\% \text{ PMF}$$

$$= 17.6\% \text{ PMF} \quad \boxed{\text{Say } 18\% \text{ PMF}}$$

DETERMINE WATER DEPTH  $h$ , above Dam Due To PMF

$$\frac{(465)(h+4)^{1.5} + (1053)(h)^{1.5}}{23000} + \frac{46x(h+4)}{13300} = 1$$

$$h = 4.637' \quad \text{Say } 4.6 \text{ FT OVERTOP DAM}$$

$$Q = 22313 \text{ cfs} \quad \text{Say } 22300 \text{ cfs}$$

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NAME OF DAM TIPTON DAM

ID# NDI: 525 DEF: 7-67

CHECKLIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOODED 9.6 SQUARE MILES

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 1120 AC-FT @ EL 1394

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: SAME AS ABOVE

ELEVATION; MAXIMUM DESIGN POOL: EL. 1398

ELEVATION; TOP DAM: EL 1393 (USGS DATUM)

CREST: (SPILLWAY)

- a. Elevation 398
- b. Type CONCRETE OVER-FLOW SECTION
- c. Width 7-0 FT
- d. Length 150 FT
- e. Location Spillover ENTIRE CREST
- f. Number and Type of Gates NONE

OUTLET WORKS:

- a. Type 36-INCH CAST IRON PIPE
- b. Location LEFT OF SPILLWAY
- c. Entrance Inverts EL 1318 ±
- d. Exit Inverts EL 1315 ±
- e. Emergency Draindown Facilities 36-INCH CAST IRON PIPE

HYDROMETEOROLOGICAL GAGES:

- a. Type NONE
- b. Location NONE
- c. Records NONE

MAXIMUM NONDAMAGING DISCHARGE: \_\_\_\_\_

APPENDIX E  
REGIONAL GEOLOGY

APPENDIX E  
REGIONAL GEOLOGY

Tipton Dam (Tipton Reservoir) is located on the northwest edge of the folded belt of the Appalachian Mountain system. The dam and reservoir are located on strata of the Devonian Age Catskill Formation. The strata dip to the northwest with the fracture systems in general trending northeast and northwest. The rock consists of thin-bedded fractured reddish-brown shales and claystones with interbedded sandstone layers. The fine-grained rocks are easily weathered while the sandstone is more resistant. The strata surrounding the reservoir consist of shales and claystones, except on the east side where sandstone predominates. Small rock falls may be expected in this area due to the weathering of the fine-grained rock strata, which results in loss of support for the more resistant sandstone layers.